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Indian Standard

METHODS FOR CALIBRATION OF SPRAYERS

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Indian Standard

METHODS FOR CALIBRATION OF SPRAYERS

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METHODS FOR CALIBRATION OF SPRAYERS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 20 November 1985, after the draft finalized by the Crop Protection Equipment Sectional Committee had been approved by the Agricultural and Food Products Division Council.

0.2 Sprayers play an important role in the successful application of pesticides. But with the continuous use of sprayers the pump and the spray nozzle may get worn out. Further strainers and the nozzles may get chocked. All these defects would cause the rate of discharge of spray fluid to be different from what is originally declared by the manufacturer. Therefore, to check the output of a sprayer, calibration of sprayers, is necessary. This standard deals with the establishment of a calibration procedure for sprayers.

0.3 In preparation of this standard assistance has been derived from ASAE EP 367·1 Guide for preparing field sprayer calibration procedures, issued by the American Society of Agricultural Engineers.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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1. SCOPE

1.1 This standard specifies the methods for calibration of boom and boomless type sprayers.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 8480-1977† shall apply.

*Rules for rounding off numerical values (*revised*).
†Glossary of terms relating to crop protection equipment.

3. TEST EQUIPMENT

3.1 Measuring Tapes — of 25, 50 or 100 m length with an accuracy of ±5 mm.

3.2 Stakes or Flags — for marking the test plot.

3.3 Measuring Cylinders — of one litre and five litres capacity graduated in 10 millimetres increments.

3.4 Pressure Gauge — of proper range and size with an accuracy of ±1 percent at the rated pressure.

4. TEST LIQUID

4.1 Fresh water shall be used unless the flow rate of actual spray mixture varies by more than 5 percent from the flow rate of water when calibrated with actual spray mixture.

5. SAFETY REQUIREMENTS

5.1 The safety precautions given in 7 of IS : 9632-1980* shall be complied with while calibrating the sprayers.

6. GENERAL REQUIREMENTS

6.1 When developing a specific calibration procedure determine the nozzle flow rate, ground speed of the sprayer and the spray width per nozzle to compute the spray volume for a given area.

6.1.1 *Nozzle Flow Rate* — Check the nozzle flow rate with nozzle capacity, nature of spray fluid and fluid pressure. Check the nozzle output by collecting the spray in a measuring cylinder over a fixed period of time with a stop watch and at a constant pressure. The output of nozzles at several positions shall be checked to determine the effect of any pressure drop along the boom.

6.1.2 *Nozzle Capacity* — Select the nozzle that would best fit the desired application volume, pressure and ground speed.

6.1.3 *Nature of Spray Fluid* — If the spray mixture would be altered by the addition of adjuvants compare the flow rate of the spray mixture to that of water. If the flow rate difference is 5 percent or more, then use the actual spray mixture in the calibration.

*Code of practice for operation and preventive maintenance of crop protection equipment.

6.1.4 *Fluid Pressure* — A constant pressure with ±5 percent variation should be maintained to achieve uniform application.

6.1.4.1 In case of lever operated sprayers, a pressure gauge shall be fitted as close to the nozzle as possible and the lever shall be operated evenly with a full stroke to maintain a uniform pressure. The operator shall practise before achieving an even pumping rate.

6.1.4.2 In case of compression sprayers a pressure regulating valve shall be fitted to regulate the pressure.

6.1.5 *Ground Speed of Sprayer* — Adjust the ground speed to suit the application rate. Ground speed shall be kept constant for uniform application.

NOTE — This does not apply to sprayers fitted with ground driven pumps.

6.1.6 *Spray Width per Nozzle* — Calibration methods given in **8.1.1** and **8.1.2** shall be used to determine the volume (litres) of liquid applied per unit area (hectare) actually treated with agricultural chemical. For band application, the area treated is the area in the band and not the area of crop land. If the pesticide recommendation is based on the area of crop land rather than the area actually sprayed, then the spray width shall be crop row spacing and not the band width.

7. CALIBRATION PROCEDURE

7.1 Nozzle Tip Selection

7.1.1 Considering the manufacturer's recommendation and field condition select a suitable spray volume and the operating speed.

7.1.2 Select a nozzle tip that would give the required output when operated within the recommended pressure range.

7.1.3 Considering the spray width, speed and spray volume calculate the nozzle output from the formula given in **8.1.1.1**.

7.2 Pre-calibration Check — Ensure that all sprayer parts are free of foreign material, if any and shall be functioning properly. Nozzle tips shall be inspected for proper size and type, wear and defects, if any. Check the flow rate of each nozzle using water at rated pressure for uniform output, equal spray angle and uniform appearance of spray pattern. Replace those nozzle tips having flow rates varying from other nozzles checked by ±5 percent and those having obviously different spray angle or pattern.

7.3 Adjustments to Obtain Desired Spray Volume

7.3.1 Adjust the operating speed to get the desired spray volume if the spray volume change is below 25 percent.

7.3.2 Operating pressure may also be adjusted to adjust the spray volume if the spray volume change is below 25 percent when operating within the recommended pressure range. The operating pressure shall be adjusted without affecting the drop size and spray pattern excessively.

7.3.3 Select few nozzle tips to obtain spray volume change more than 25 percent.

7.4 Layout of Test Plot — Lay out a measured course length to the nearest 0·1 m in the test plot. The course length shall be selected depending upon the travel speed, spray width and spray volume. The course length shall be long enough that an accurate measure can be made of time (at least 15 seconds) or of spray volume (at least 10 percent of tank volume) whichever method is used.

8. CALIBRATION METHODS

8.1 Any of the following methods shall be used for determining the spray volume.

8.1.1 Select representative nozzle(s) and direct the spray at desired operating pressure. Measure the liquid sprayed from the nozzle(s) while operating under the following conditions:

a) Over the measured course length;

b) Over the period of time equivalent to the travel time over the measured course length, and;

c) Over a fixed period of 5 minutes.

8.1.1.1 The spray volume and the nozzle output shall be computed from the following formulae:

a) $V = \frac{\text{Quantity of spray}}{\text{Area treated}}$

b) $V = \frac{600 \times Q}{SW}$

c) $Q = \frac{V\,SW}{600}$

where

V = spray volume, l/ha;

Q = output per nozzle, l/min;

S = speed, km/h;

W = spray width, m;

Quantity of spray = volume of liquid in litres sprayed by the nozzle or boom on a measured course length or in the equivalent time.

Area treated = area actually treated, ha.

NOTE — Spray width for different types of spraying shall be as follows:

a) Nozzle spacing for boom spraying;

b) Spray swath width for boomless spraying;

c) Band width for band spraying;

d) For row crop spraying, the spray width per nozzle is equal to the row spacing (or band width) divided by the number of nozzles per row (or band).

8.1.2 The quantity of spray required to refill the tank after operating under the conditions given in **8.1.1** shall be measured. An accurate liquid level mark shall be used or fill the tank to overflowing before the calibration run and then measure the quantity required to refill the tank to overflowing after the run. The boom and the distribution lines shall be full before and after operation. For accurate measurement the sprayer shall be in a level surface while taking measurements.

8.1.2.1 The spray volume shall be computed from the formulae given in **8.1.1.1**.

8.2 The sprayer shall be recalibrated periodically to find out any changes in the variables listed in **6** due to nozzle wear, pump wear, strainer and nozzle chocking, etc.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	$1\ N = 1\ kg.m/s^2$
Energy	joule	J	$1\ J = 1\ N.m$
Power	watt	W	$1\ W = 1\ J/s$
Flux	weber	Wb	$1\ Wb = 1\ V.s$
Flux density	tesla	T	$1\ T = 1\ Wb/m^2$
Frequency	hertz	Hz	$1\ Hz = 1\ c/s\ (s^{-1})$
Electric conductance	siemens	S	$1\ S = 1\ A/V$
Electromotive force	volt	V	$1\ V = 1\ W/A$
Pressure, stress	pascal	Pa	$1\ Pa = 1\ N/m^4$